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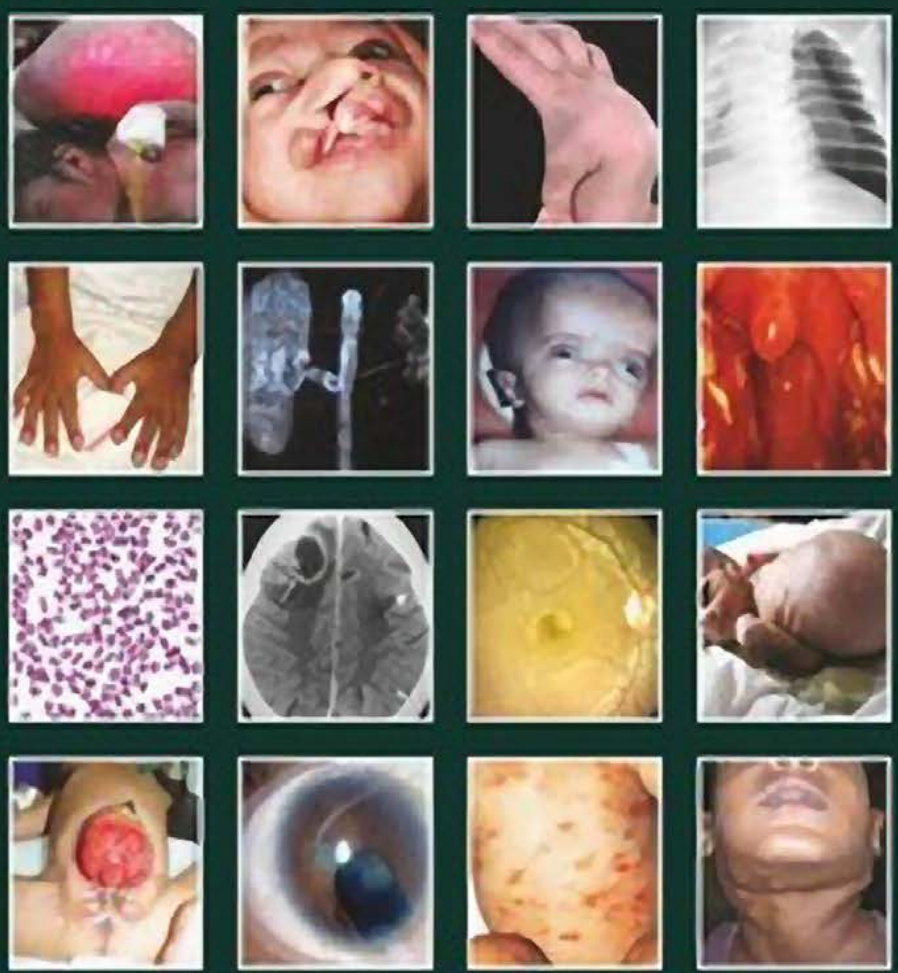

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JAYPEE

Section 1

Neonatology

Section Editors

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Photo Courtesy

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Section Outline

1.1 NORMAL NEWBORN

Picture	Note	Management
Acrocyanosis		
 **Figure 1.1.1:** Acrocyanosis *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the central portion (chest) of the body appears pink but the extremities, particularly the palms and soles are blue. The skin and mucosa are spared.	• Acrocyanosis is common, transient, self limiting condition seen after birth, disappearing over the next few hours. • It must be differentiated from central cyanosis (bluish discoloration of skin, mucous membranes), which is not normal and indicates need for urgent evaluation. • Acrocyanosis is also seen in babies with cold stress.
Breast Engorgement		
 **Figure 1.1.2:** Breast engorgement *Photo Courtesy*: Anirudh Thakre, Pune	Note the bilateral fullness of both the breasts. The overlying skin shows no signs of redness, warmth or local tenderness. At times, there may be milky discharge from the breasts called "witch's milk", which is a benign phenomenon.	• The condition resolves spontaneously and no intervention is required; just reassurance. • It results from stimulation of breast tissue by high levels of maternal hormones. • Massage or squeezing the breasts or nipples is not recommended as this may lead to breast infection (Mastitis).
Capillary Refill Time		
 **Figure 1.1.3:** Capillary refill time (CRT) *Photo Courtesy*: Ruchi Nanavati, Mumbai	The picture shows capillary refill time (CRT) being assessed by blanching of the skin following gentle digital pressure over the sternum. Such blanching usually recovers within 3 seconds and is considered normal. If this blanching extends beyond 3 seconds, then it suggests poor perfusion and is one of the signs of shock.	• Assessment of CRT is an integral part of newborn assessment for perfusion. • CRT in neonates is best assessed over central areas like sternum or forehead. It is not assessed over extremities as it may be influenced by environmental temperature.

Picture	Note	Management

Caput Succedaneum

 **Figure 1.1.4:** Caput succedaneum *Photo Courtesy*: Vishal Pawar, Aurangabad	Note the diffuse, soft, puffy, scalp swelling, crossing the suture line with variable degree of discoloration or bruising. Caput is present at birth unlike cephalhematoma which appears after 24 to 48 hours.	No tests or treatment is necessary. Caput usually subsides spontaneously within a few days.

Feeding Cues

 **Figure 1.1.5:** Feeding cues *Photo Courtesy*: Ruchi Nanavati, Mumbai	Note the mouthing-getting hands, fingers to face and mouth—with lip smacking movements which are clues to signs of hunger. These are associated with periods of alertness and wakefulness with drooling, at times. Cry is a late and last of hunger signs in newborn.	• A healthy infant should be given the opportunity to show hunger, optimal reflexes and attachment to the areola by itself. Cue-based breastfeeding is a pleasurable experience for both, mother and baby. • Forcing infant to the breast can be counterproductive as it might disturb the rooting reflex and alter the tongue position, as the infant reflexively raises tongue to protect airway.

Normal Newborn

 **Figure 1.1.6:** Normal newborn *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the newborn appears pink, has vigorous activity, with good muscle tone (note the flexion of elbows and knees). Following establishment of cry at birth, the heart rate is in normal range (120-180 per min) with regular respiration (40-60 per min).	• The cord is clamped and cut at birth and the newborn given straight to the mother for skin to skin contact and to establish breastfeeding. • The essential care for all newborns at birth includes helping to breathe, maintain temperature, asepsis care and exclusive breastfeeding within first hour of life. • All newborns at birth should receive Inj vitamin K, 1 mg, IM to prevent hemorrhagic disease.

Picture	Note	Management

Skin Peeling

 **Figure 1.1.7:** Skin peeling *Photo Courtesy*: Anirudh Thakre, Pune	Note the fine, diffuse scaling and peeling of the skin at thigh and soles. The underlying skin is perfectly normal, soft, and moist. There is no hair loss, shiny membrane formation or signs of inflammation. This is typically seen from the second day of life and last a few days.	• Skin peeling is a natural phenomenon in term and postdated babies. It does not need any creams, oil, ointment or lotions. • Excessive peeling is seen in pathological conditions like placental dysfunction, congenital syphilis and candidiasis.

Skin Tags

 **Figure 1.1.8:** Skin tags *Photo Courtesy*: Ruchi Nanavati, Mumbai	Note the prominent, pedunculated skin lesions 1 to 2 cm in length over the cheek near the angle of the mouth and in the preauricular area with a narrow base. The tags show no overlying inflammation and are painless.	• When associated with other craniofacial anomalies, hearing assessment is warranted. • These skin tags pose more of cosmetic problem and rarely become infected.

Vaginal Discharge

 **Figure 1.1.9:** Vaginal discharge *Photo Courtesy*: Nidhi Bagdia, Aurangabad	This newborn girl has a creamy, thick vaginal discharge. This may be noted intermittently, during first few days of life; sometimes associated with vaginal spotting or bleeding.	The condition is self limiting and is due to withdrawal of maternal hormones. It requires no treatment, just some gentle reassurance. It subsides by first few weeks of life.

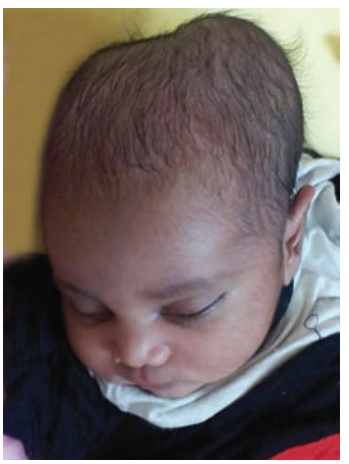
Picture	Note	Management

Vernix Caseosa

 **Figure 1.1.10:** Vernix caseosa *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note that the entire body and the skin folds—thigh, axilla and face at birth is covered by a creamy white substance. Vernix appears primarily in full-term infants and is rarely seen in preterm and postdated babies.	• Vernix facilitates passage through birth canal, prevents transepidermal water loss, helps maintain body temperature, protects the delicate skin from environmental stress, and has skin cleansing, antioxidant, wound healing and probably antibacterial properties. • Removing vernix for cosmetic reasons is not recommended.

1.2 COMMON NEONATAL CONDITIONS

Cephalhematoma

 **Figure 1.2.1:** Cephalhematoma *Photo Courtesy*: PS Patil, Aurangabad	There is a firm, scalp swelling with clear edges not crossing the suture lines (in contrast to caput) over the left parietal bone. This subperiosteal swelling gradually hardens (calcification) leaving a relatively soft center and fades away in first few months.	• In majority, the management is mainly observation and assurance to parents. • If significant, the newborn may develop jaundice, anemia or hypotension. • Skull X-ray or CT scan is done, if neurological symptoms appear or concomitant skull fracture is suspected. • Aspiration is not recommended as it increases risk of infection.

Contact Dermatitis

 **Figure 1.2.2:** Contact dermatitis *Photo Courtesy*: PS Patil, Aurangabad	Note the skin fold at the neck shows erythematous, moist lesion extending to the adjoining area. The infant is cranky on handling the lesion. This is usually due to irritation of skin by sweat, soap, oil or lotions. If the clothes are tight, they rub the site, worsening the condition and pain causing excessive crying.	• Removing the cause of irritation is the first step. Such babies need to be bath with warm water followed by drying the skin thoroughly with a clean, soft cloth. • Applying moisturizer or petroleum jelly is helpful. Use loose fitting clothes that allow the skin to breath. Heavy clothes can cause baby to sweat, making the site worse. • Application of zinc oxide cream and mild steroid in non-flexural areas is helpful.

Picture	Note	Management

Erb's Palsy

 **Figure 1.2.3:** Erb's palsy *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the *Waiter's tip deformity* sign—the left arm hangs by the side and is rotated medially; the forearm is extended and pronated. The arm cannot be raised from the side; all power of flexion of the elbow is lost, as is also supination of the forearm. Deep tendon reflexes are absent.The hand and wrist are spared and there is a normal grasp. This is characteristic of Erb's palsy (C5-8) which accounts for 90% of all brachial plexus injuries. Klumpke's paralysis (C8-T1) leads to clawed hand with inability to grasp or flex wrist.	• Many Erb's palsy infants improve or recover spontaneously. Onset of recovery within 2 to 4 weeks is a favorable sign. Presence of "antigravity" movement by the end of the third month is an excellent prognostic sign. • Klumpke's palsy and total plexus injuries have worse prognoses. • If there are no signs of improvement by 3 to 6 months, spontaneous improvement is unlikely, and surgical exploration can be considered.

Infant of Diabetic Mother

 **Figure 1.2.4:** Infant of diabetic mother *Photo Courtesy*: Sheila Mathai, Mumbai	The baby is large for gestation (birth weight > 90th percentile). The infant has excessive fat deposition in cheeks, neck (which is almost buried), trunk and the extremities. The pinnae may be hairy and may be a clue to diabetes in mother.	• Cord sugar estimation should be done in delivery room to predict subsequent hypoglycemia. • Management involves supervised, early, frequent feeding, close clinical monitoring for complications, and screening and treatment of hypoglycemia.

Intrauterine Growth Retardation (IUGR)

 **Figure 1.2.5:** Intrauterine growth retardation *Photo Courtesy*: Bonny Jasani, Mumbai	Note the IUGR baby appears small with generalized loss of subcutaneous fat. The extremities are thin, the baby looks alert but emaciated. The head appears large compared to the body. When the weight is less than 10th percentile for gestation it is called SGA (small for gestational age).	Problems unique to IUGR babies include hypothermia, hypoglycemia, polycythemia, meconium aspiration and jaundice. Closed supervision and early detection of the problems is required.

Picture	Note	Management

Jaundice

Picture	Note	Management
 **Figure 1.2.6:** Jaundice *Photo Courtesy*: Ruchi Nanavati, Mumbai	Note the yellowish discoloration of skin over the trunk, thighs and extremities. The eyes and genitalia are covered to protect from phototherapy light. Jaundice is assessed in bright light, with the infant naked, by blanching the skin with finger pressure to observe for underlying yellowing of skin. Jaundice assessment for infants receiving phototherapy is unreliable.	• Visual inspection is not a reliable indicator to estimate the extent of jaundice. • The gold standard of jaundice estimation is total serum bilirubin (TSB). When TSB is > 95th percentile for age in hours, as per AAP guidelines, detailed evaluation is mandatory.

Oral Thrush

Picture	Note	Management
 **Figure 1.2.7:** Oral thrush *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	The picture shows white, curdish plaques over the tongue, buccal mucosa, extending upto soft palate. These lesions cannot be removed and bleed on scrapping. There may be chelosis of the angle of the mouth and concomitant diaper dermatitis. These lesions usually present with feeding difficulty.	• Oral thrush is a common fungal infection caused by *Candida albicans*. The diagnosis is clinical. • The treatment of choice is oral nystatin suspension. Simultaneous treatment of maternal nipple infection is must.

Preterm

Picture	Note	Management
 **Figure 1.2.8:** Preterm *Photo Courtesy*: Anirudh Thakre, Pune	Note the baby appears small, the skin is thin, shiny, smooth and uniformly pink. The breast buds may be absent or just palpable and the ear recoil is slow or absent. The ear pinnae appear smooth with little or no palpable ear cartilage. There may be lanuago—excessive body hairs over the back, trunk and forehead. In males, the scrotum has less of rugosity, testis are not in the scrotal sac. In females, the labia majora are spread out with labia minora visible. The soles may show few creases in the anterior third.	• A combination of physical and neurolgic signs (using New Ballard score or Modified Dobowitz score) is used for gestational assessment. • Common problems of preterms include hypothermia, respiratory distress syndrome, poor oro-motor coordination, patent ductus arteriosus, necrotizing enterocolitis and intraventricular hemorrhage.

Picture	Note	Management

Pustules

 **Figure 1.2.9:** Pustules *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the periumbilical area shows evidence of pustles. The adjacent skin shows erythema. At times, there may be induration, hardening of the adjoining skin with pus discharge.	• A few lesions in a healthy term infant may be treated with topical antibiotic and oral therapy. • More extensive lesions, systemic illness, or pustulosis occuring in the premature infant requires intravenous therapy. Most common causative organism is *Staphylococcus aureus*.

Seborrheic Dermatitis (Cradle cap)

 **Figure 1.2.10:** Seborrheic dermatitis (Cradle cap) *Photo Courtesy*: PS Patil, Aurangabad	Note the greasy, yellow plaques on the scalp with some degree of hair loss. Pruritus is infrequent unlike atopic dermatitis. Such lesions are highly prevalent during the first 4 weeks of life and primarily affect in addition the intertriginous areas.	In mild cases, the condition is self-limited. Treatment options include gentle scrubbing, applying vaseline and using a soft brush to remove scale. Occasionally, topical mild corticosteroid or antifungal is indicated.

Umbilical Granuloma

 **Figure 1.2.11:** Umbilical granuloma *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	There is a well-circumscribed, friable, moist, pinkish tissue at the base of the umbilicus. It may produce variable amounts of drainage that can irritate the surrounding skin. Such lesion differs from an umbilical polyp (represents retained intestinal or gastric mucosa from the vitelline duct) which is brighter red than a granuloma and does not respond to silver nitrate cauterization.	• Small umbilical granuloma usually respond to application of crystal salt or silver nitrate. • Large umbilical granuloma or those that persist after silver nitrate treatment require surgical excision.

Picture	Note	Management

Undescended Testis

 **Figure 1.2.12:** Undescended testis *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note that the scrotal sac appears empty with incomplete overlying rugosity. Both the testis cannot be palpated in the scrotum. Retractile testes are commonly confused with undescended testes. Retractile testis can be delivered into the scrotum, stay in the scrotum and have a well developed scrotum.	• First physical examination of newborn must confirm testis are in scrotum. • Patients with undescended testes should be referred for surgical evaluation no later than 3 months of age. • A child with bilateral nonpalpable testes should have an endocrine evaluation to rule out anorchia or intersex. • Definitive treatment is surgical (orchiopexy) but GnRH and hCG are used, with success rates of 30 to 50%.

1.3 NEONATAL SYSTEMIC DISORDERS

Abdominal Distention

 **Figure 1.3.1:** Abdominal distention *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note the infant has generalized abdominal distention with transversely stretched umbilicus. The upper segment is more prominent than the lower segment. A feeding tube is *in situ* to aspirate the abdominal contents to monitor the color, frequency and consistency of the aspirate. The veins over the abdomen are prominent and some abdominal loops visible suggesting a pathological cause. In all cases, anal patency should be confirmed. When associated with recurrent vomiting, absent bowel sounds, profuse vomiting—clear or bilious, constipation, failure to thrive, surgical cause needs to be ruled out.	• Abdominal distention may result from aerophagia, fluid accumulation, organomegaly, lump or intestinal obstruction. • Progressive abdominal distention warrants search for underlying cause. X-ray abdomen may be diagnostic for intestinal obstruction. If inconclusive, electrolytes, urine, USG, sepsis screen, CT imaging with contrast may be needed.

Acholic Stools

 **Figure 1.3.2:** Acholic stools *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	The stools appear clay colored or pale. The normal yellow color of the stools is because of presence of bile pigments. Decreased bile production or block in the bile flow leads to clay or acholic stools. Jaundice often occurs with acholic stools suggesting underlying cholestasis—direct hyperbilirubinemia with high colored urine staining the cloth.	Acholic or clay stools result from disorder in the biliary system (the drainage system of the gallbladder, liver, and pancreas) and manifests with cholestasis. Cholestasis is always pathological and needs expert evaluation.

Picture	Note	Management

Achondroplasia

 **Figure 1.3.3:** Achondroplasia *Photo Courtesy*: Ruchi Nanavati, Mumbai	• Picture shows a newborn with short limb dwarfism, upper to lower segment ratio > 1.7:1. Also note short extremities, megalocephaly, coarse faces, frontal bossing, low nasal bridge, protruding jaw and relatively small thorax. • The hands are short and stumpy and the feet may be short flat and broad. The lifespan and intelligence is 'normal' in majority.	• Most cases appear as spontaneous mutations. • Children are at risk of recurrent otitis media, bowing of legs, respiratory problems, hydrocephalus, motor delay and psychosocial problems. • Diagnostic modalities include prenatal ultrasound, DNA tests for homozygosity and radiological survey. • There is no specific treatment.

Anal Agenesis

 **Figure 1.3.4:** Anal agenesis *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note the male infant has no anal opening suggesting anal agenesis—an anorectal malformation. There may be associated fistulae between the rectum, and the urinary, or the genital tracts. Such infants present soon after birth with abdominal distention and failure to pass meconium.	• First physical examination of newborn must confirm anal orifice presence and patency. • An invertogram or lateral pelvic radiography at 24 hours of age is used to type the lesion with relation to puborectalis sling. The treatment is surgical.

Beckwith-Wiedemann Syndrome

 **Figure 1.3.5:** Beckwith-Wiedemann syndrome *Photo Courtesy*: KP Sanghvi, Mumbai	This shows macrosomia, macroglossia, omphalocele usually associated with visceromegaly. These infants have prominent occiput, transverse crease on the ear lobe, hemihypertrophy, nevus flammeus and hyperinsulinemic hypoglycemia.	• Usually sporadic occurrence. • May present as persistent hypoglycemia

Picture	Note	Management

Bilirubin Encephalopathy

Picture	Note	Management
 **Figure 1.3.6:** Bilirubin encephalopathy *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the yellowish discoloration of the infant extending up to the soles with setting sun sign—visible upper sclera with yellow staining. There is arching of the back, straightening of both the upper limbs suggesting hypertonia. Such infants have asymmetric or absent Moro's reflex with shrill cry. These signs suggest neurologic dysfunction secondary to unconjugated bilirubin binding to the brain.	• Exchange transfusion and intensive phototherapy is treatment of choice. • In early phase, interventions can reverse brain damage. With established encephalopathy brain damage is not reversible.

Capillary Leak Syndrome

Picture	Note	Management
 **Figure 1.3.7:** Capillary leak syndrome *Photo Courtesy*: Anirudh Thakre, Pune	Note the edema of hands and lower limbs extending up to the feet. The overlying skin is shiny and stretched out due to dependent edema. Such infants develop hypotension, hemoconcentration, hypoalbuminemia, multiple organ failure due to capillary leak syndrome which is leakage of fluid from the circulatory system to the interstitial space. It is commonly seen with severe sepsis, asphyxia, renal failure, severe liver disease and systemic inflammatory response syndrome.	Treatment of the underlying cause, aggressive supportive care with vasopressor therapy and judicious fluid replacement is the key.

Cyanosis

Picture	Note	Management
 **Figure 1.3.8:** Cyanosis *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Note the bluish discoloration of the sole. It is due to increased concentration of reduced hemoglobin (>5 gm%) in the blood. Central cyanosis is characterized by dusky skin and mucus membranes. Peripheral cyanosis involves the hands and feet without affecting the mucosa and the central body. Central cyanosis is a "danger sign" in newborn.	Cyanosis can result from a range of disorders, including hypothermia, cardiac, parenchymal/ non-parenchymal pulmonary, metabolic, hematologic and neurological disorders. Cyanotic newborn requires systematic approach, urgent assessment, diagnosis, and initiation of therapy.

Picture	Note	Management

Gastroschisis

 **Figure 1.3.9:** Gastroschisis *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note the abdominal wall defect arising outside the umbilical ring and the herniated bowel not covered by peritoneum or amnion. The defect measures 2 to 4 cm and usually lies just to the right of the umbilicus. The organs extruded other than bowels at times include stomach, urinary bladder, uterus and adnexa. The earlier the rupture, the more matted the bowel. Unlike omphalocele, gastroschisis is less commonly associated with other anomalies.	Avoid handling exposed bowel. Wrap bowel in sterile, moist or waterproof material to prevent drying, heat and water loss, and infection. Following stabilization primary closure is done.

Hydrops

 **Figure 1.3.10:** Hydrops *Photo Courtesy*: Sanjay Aher, Nashik	Shows generalized edema of body, trunk, and extremities. The infant is intubated at birth due to poor lung expansion as a result of pleural effusion and ascites. There may be pericardial effusion, polyhydramnios and placental edema. Fetal hydrops as a physical sign carry the stigma of poor prognosis to the extent that hydrops itself is taken as diagnosis.	• Historically associated with Rh-isoimmunization. However, currently nonimmune conditions are major causes of hydrops. • Careful history, selected diagnostic studies are mandatory to identify the cause but etiology sometimes may remain elusive in 20% of hydrops cases. • Management is complex and requires advanced preparation.

Inguinal Hernia

 **Figure 1.3.11:** Inguinal hernia *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note the bulge localized to the left inguinal area. At times, it may extend into the scrotum. The bulge becomes prominent on straining or crying. The swelling is painless and shows no signs of inflammation.The right side is unaffected. The hernia is due to protrusion of abdominal contents through the inguinal canal outside the peritoneal cavity.	• The diagnosis is made on the basis of the clinical history and examination. However, in some cases, use of scrotal or inguinal ultrasonography is indicated. • Treatment is surgical, as early as possible, for fear of obstruction or strangulation of the hernia.

Picture	Note	Management

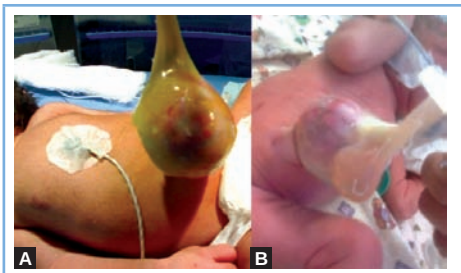
Meconium Plug Syndrome

 **Figure 1.3.12:** Meconium plug syndrome *Photo Courtesy*: Amit Jagtap, Mumbai	The picture shows tenacious string of meconium passed which is usually by 24 to 48 hours. The lower bowel contents could be too dry and extensive forming a plug causing lower bowel obstruction. It is a diagnosis of exclusion. Meconium ileus is impaction of meconium more proximally, usually in the terminal ileum.	Plain films with contrast enema is diagnostic and show the outline of the meconium plug. In general, this disease is observed in premature newborns who are otherwise normal. However, cystic fibrosis and Hirschsprung's disease may be associated with process and should be excluded.

Meningomyelocele

 **Figure 1.3.13:** Meningomyelocele *Photo Courtesy*: Ramesh Sitaram Bajaj, Aurangabad	Note the defect over the lumbar spine with visible lesion with intact skin cover with no discharge, protruding from the spinal canal containing the spinal cord with the meninges suggesting a meningomyelocele—a neural tube defect. Such infants also have affection of the nerves to the bladder, bowel and lower extremities. The higher the level of the defect, the more severe the associated nerve dysfunction and resultant paralysis. It may occur in isolation or with other congenital malformations including midline defects.	• An open meningomyelocele is closed early to protect against infection. A ventriculoperitoneal shunt may be required for associated hydrocephalus. • A multidisciplinary approach for long-term management is must. • Folic acid supplement is advocated prior to conception for prevention of neural tube defects.

Omphalocele

 **Figures 1.3.14A and B:** Omphalocele *Photo Courtesy*: Sanjay Lalwani, Pune Ruchi Nanavati, Mumbai	Note the herniation of the intestines through the base of the umbilicus covered by intact skin. The underlying intestines are easily seen (Fig. 1.3.14B) but with passage of time skin growth takes place over the defect if the repair is delayed (Fig. 1.3.14A). Up to 40% of infants with an omphalocele have other birth defects.	Diagnosis is clinical and no tests are required. The size of the herniation determines the mode of delivery as well as the postnatal treatment of omphalocele, while the degree of liver involvement determines the level and type of omphalocele treatment.

Picture	Note	Management

Pierre-Robin Sequence

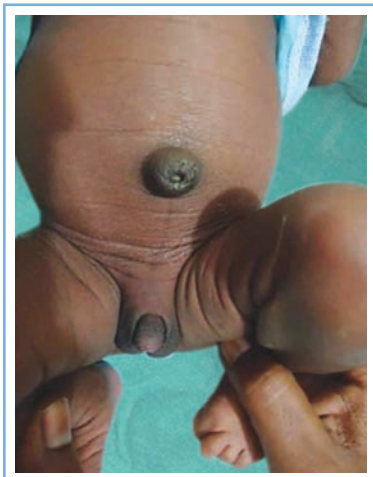
 **Figure 1.3.15:** Pierre-robin sequence *Photo Courtesy*: Srinivas Murki, Hyderabad	Note the combination of micrognathia, retrognathia leading to glossoptosis and cleft palate. These may cause upper airway obstruction. Such babies have feeding problems, aspiration, ear infections, reduced hearing, or may be part of syndrome. Most of these babies grow to lead a healthy and normal adult life.	• No special diagnostic tests are required. Management involves supervised feeds, head high nursing, prone or lateral positioning, and at times nasopharyngeal airway. • Surgical options include tongue-lip ankylosis, mandibular distraction and cleft palate repair. The small jaw usually outgrows during the first two years, and no jaw surgery is necessary.

Polycythemia

 **Figure 1.3.16:** Polycythemia *Photo Courtesy*: Ruchi Nanavati, Mumbai	Note the sole appear flushed and pink red. Such a baby appears plethoric—body color appears uniformly red. A diagnosis of polycythemia is made in such a baby if the hematocrit is > 65%. Commonly seen with conditions causing increased placental transfusion, placental insufficiency and IUGR.	• Routine screening of term well neonates is not indicated. • In high-risk infants (e.g. SGA), hematocrit is done 6 to 8 hours following birth. • Partial exchange transfusion is done with normal saline if hematocrit is ≥ 70 % (even in an asymptomatic infant) and ≥ 65% in symptomatic infant.

1.4 UNCOMMON NEONATAL CONDITIONS BUT NOT RARE

Ambiguous Genitalia

 **Figure 1.4.1:** Ambiguous genitalia *Photo Courtesy*: Anuradha Khadilkar, Pune	Note the baby is darkly pigmented (more so on genitals, umbilicus), has clitoral hypertrophy and impalpable gonads. Common presentation is salt wasting crisis—unexplained shock, metabolic acidosis, hyponatremia and hyperkalemia.	• Commonest cause of ambiguous genitalia is congenital adrenal hyperplasia (CAH). • Baseline tests include 17-hydroxyl progesterone (reference range < 6 nmol/L), adrenocorticotrophic hormone assay (reference range 2–11 pmol/L) which are elevated and karyotyping (46XX female) confirming the diagnosis of salt wasting type of CAH. • These infants require replacement therapy with glucocorticoids (hydrocortisone 10–20 mg/m^2/day) and mineralocorticoids (fludrocortisone 100–200 µg/day).

Picture	Note	Management

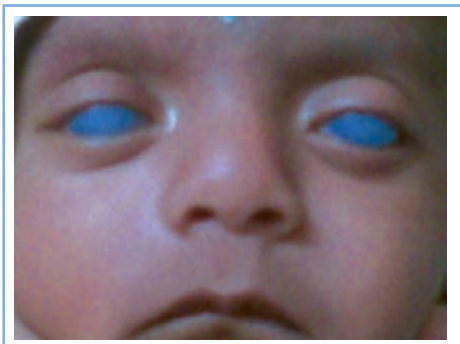
Chickenpox

 **Figure 1.4.2:** Chickenpox *Photo Courtesy*: Sanjay Ghorpade, Satara	Note the generalized vesicular eruption with rash in varying stages across the body. The infant is afebrile with no eye affection with history of maternal chickenpox. Neonatal chickenpox within the first 4 days after birth is usually mild.	• Nurse mother and baby together but isolate from other patients. Continue breastfeeding. • Admit the infant into hospital isolation room who has rash or is unwell. • Zoster immunoglobulin is given (2 ml, IM) for very preterm babies or to infants whose mother develops chickenpox 1 week on either side of delivery. • Aciclovir is given to infants who develop chickenpox with maternal history of chickenpox, 4 days before to 2 days after delivery.

Clubfoot—Congenital Talipes Equinovarus (CTEV)

 **Figure 1.4.3:** Congenital talipes equinovarus *Photo Courtesy*: Srinivas Murki, Hyderabad	Note both the feet are affected and rotated internally at the ankle. It is classified as postural (can be manipulated) or structural deformity (fixed deformity). Similar deformities are seen with myelomeningocele hence always look for spinal dysraphism and defects of the spine in such babies.	• Approximately 50% of clubfeet in newborns can be corrected non-operatively. • Foot manipulation should begin within 2 weeks of birth by gentle stretching and repeated casting. A special brace is worn thereafter nearly full time for 3 months using it up to 3 years. Often tenotomy works. • For severe cases surgery is required.

Congenital Glaucoma

 **Figure 1.4.4:** Congenital glaucoma *Photo Courtesy*: Snehal Thakre, Aurangabad	Picture shows diffuse corneal opacity with bilateral enlargement of globe (buphthalmos). Congenital glaucoma is the commonest cause of buphthalmos. Such infants have elevated intraocular pressure (IOP), edema, and opacification of the cornea. Symptoms include photophobia, blepharospasm, and excessive tearing (hyperlacrimation). It may be associated with other ocular and/or systemic findings.	• Examination under anesthesia (EUA) is first required to confirm diagnosis. • Treatment includes goniotomy or trabeculectomy. Up to 50% of children do not achieve vision better than 20/50 despite treatment. If untreated, optic atrophy ensues.

Picture	Note	Management

Collodion Baby

 **Figure 1.4.5:** Collodion baby *Photo Courtesy*: KP Sanghvi, Mumbai	Note the infant is encased in a tight, shiny, hard, inelastic scale, resembling oiled parchment. Tightness of membranes may cause ectropion (eversion of eyelids), eclabium (turning out of the lips), flattening of ears and nose with absence of hairs. The collodion membrane cracks and peels over course of time. These infants are at increased the risk of infection, dehydration, fluid loss, electrolyte imbalance, body temperature instability, and pneumonia.	• Most collodion babies do have a form of ichthyosis. • Collodion babies need to be nursed in high humidity environment, and monitored closely for complications. Application of mild petroleum-based moisturizers is helpful. • A consult with a pediatric dermatologist is necessary.

Epidermolysis Bullosa

 **Figure 1.4.6:** Epidermolysis bullosa *Photo Courtesy*: Sanjay Ghorpade, Satara	Picture shows vesicobullous eruptions in different stages over extremities, chest and abdomen. EB is a disorder that causes the skin to be fragile leading to formation of painful blisters over skin and mucous membranes. Severity ranges from simple non-scarring bullae to severe forms with multiple large lesions with loss of large areas of epidermis.	• Mild forms do not need treatment. A skin biopsy is done to type the disease. • Prevention of infection and protection of fragile skin surfaces is the goal of treatment.

Fungal Dermatitis

 **Figure 1.4.7:** Fungal dermatitis *Photo Courtesy*: Srinivas Murki, Hyderabad	Note the erythematous rash that tends to occur in the creases, in the groin, in the skin folds and buttocks and is usually very red with smaller spots called "satellite" lesions. There are usually no other associated signs or symptoms. The rash is painless and is not itchy. In contrast, contact dermatitis does not involve the groins.	The area is kept dry and frequently exposed to air. Apply antifungal cream topically.

1.5 NEONATAL DIAGNOSTIC IMAGING

Picture	Note	Management
Congenital Diaphragmatic Hernia (CDH)		
 **Figure 1.5.1:** Congenital diaphragmatic hernia *Photo Courtesy*: Naveen Bajaj, Ludhiana	Radiograph shows presence of intestinal loops in the left hemithorax with shift of mediastinum to the right. Please note the absence of the intestinal gas. CDH is suspected in newborn who presents with scaphoid abdomen, respiratory distress, cyanosis and dextrocardia with history of polyhydramnios. The differential diagnosis of X-ray includes congenital cystic adenomatoid malformation (CCAM), cystic pulmonary interstitial emphysema and staphylococcal pneumonia with pneumatocele formation.	• CDH often occur with polyhydramnios and usually after routine prenatal 16 weeks USG. Many cases are therefore diagnosed postnatally. • In antenatally diagnosed cases, all infants should be intubated at birth. Bag and mask resuscitation is contraindicated. • Factors associated with better prognosis are herniation after 2nd trimester, absence of liver herniation, coexisting cardiac anomalies and late onset of postnatal symptoms. • Priority is in stabilization followed by surgery.
Congenital Lobar Emphysema (CLE)		
 **Figure 1.5.2:** Congenital lobar emphysema *Photo Courtesy*: Naveen Bajaj, Ludhiana	Radiograph shows large lucent left hemithorax with lower lobe compressed inferomedially with the shift of mediastinum to the opposite side. Differential diagnosis of large lucent hemithorax includes pneumothorax, CAM I, obstructive hyperinflation like CLE, vascular anomaly, or compensatory emphysema seen with contralateral agenesis, hypoplasia or collapse. In CLE, left upper lobe is most commonly involved followed by the right upper lobe and middle lobe. Cardiac anomalies are frequently seen in neonatal CLE.	• Airtrapping occurs within one or more lung lobes at birth producing obstructive emphysema which may be due to a malformation, a cyst in the bronchus, or a mucus/meconium plug in the bronchus. • Bronchoscopy may be performed to remove any obstructive material or rupture a bronchogenic cyst. • Pulmonary resection is usually necessary. • Overzealous bag and mask/ mechanical ventilation as well as insertion of intercostal drain following misdiagnosis as pneumothorax may result into tension pneumothorax. Under this situation, immediate thoracotomy with lung resection is the only option.

Picture	Note	Management

ET Position

 **Figure 1.5.3:** ET Position *Photo Courtesy*: Ruchi Nanavati, Mumbai	Radiograph shows the tip of ET tube at the level of C5 vertebra. Tip of tube should normally be just above the carina (i.e. between T1 to T3). Determination of placement of ET tube after intubation is done clinically first and confirmed by chest radiograph. The position can be confirmed by following both of the mainstem bronchi back to the carina and cephalad to the tip of the tube. The ET tube should also be positioned with the bevel in an anterior placement to avoid bevel abutting against the tracheal wall with head movement or position changes.	• Clinically, the rule of 7-8-9 is useful for ET positioning: Tip to lip measurement: add 6 to the newborn's weight in kg. • Neutral position of the head is a pre-requisite while taking X-ray films. With the flexion of the head, the tube may move into right main bronchus and into the neck with extension. • Ventilation with malpositioned tube damages the lungs.

NEC Stage II

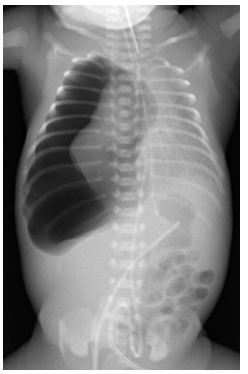
 **Figure 1.5.4:** NEC Stage II *Photo Courtesy*: Amit Jagtap, Mumbai	The picture depicts bubbly or cystic gas pattern within the walls (submucosal) of small intestine described as pneumatosis intestinalis which is a radiologic hallmark of serious NEC. It denotes Stage IIa by Bell's staging criteria. Subserosal gas is seen as curvilinear shadows.	Loss of normal symmetric pattern of bowel gas distribution leading to asymmetrical or disorganized pattern is early radiological sign of NEC. There may be relative paucity of gas in one area with dilatation in other. The films may reveal bowel wall edema, fixed position bowel loop on serial radiographs.

Pneumoperitoneum

 **Figure 1.5.5:** Pneumoperitoneum *Photo Courtesy*: Ruchi Nanavati, Mumbai	Radiograph shows football abdomen with gas under both the leafs of diaphragm indicating pneumoperitoneum. The most common cause of pneumoperitoneum in preterm neonates is NEC.	GI perforation is the indication for surgical intervention. In extremely sick infants, peritoneal drainage may be the only option. Isolated intestinal perforation may present with pneumoperitoneum without other clinical signs.

Picture	Note	Management

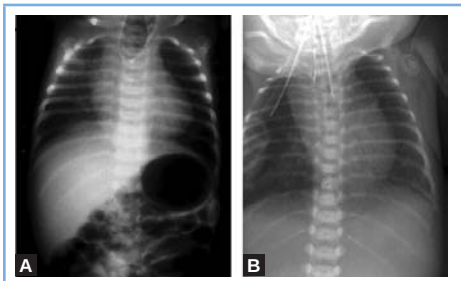
Pneumothorax

 **Figure 1.5.6:** Pneumothorax *Photo Courtesy*: Sankaranarayanan Krishnamoorthy, Salford	X-ray shows free air in right hemithorax with collapse of the underlying lung towards hilum. There are absent air markings distal to the lung shadow, increased intercostal distance, flattening of the dome of diaphragm on right side with shift of mediastinum to the opposite side suggesting tension pneumothorax. Symptomatology is depending upon the degree and severity of pneumothorax.	• Diagnosis is suspected in infant with unexplained desaturations, deterioration or sudden collapse. Absent or decreased airentry on one side with shift of mediastinum to the opposite side clinches clinical diagnosis. • Diagnostic tap in the second intercostal space or transillumination is bedside tool. With mediastinal shift, intercostal drain is required.

Postextubation Collapse

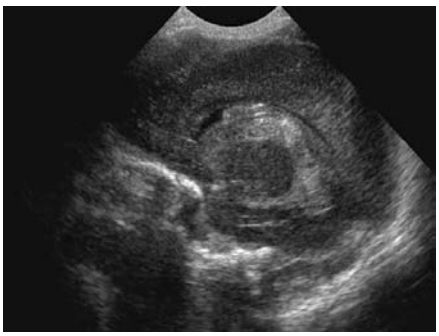
 **Figure 1.5.7:** Postextubation collapse *Photo Courtesy*: Ruchi Nanavati, Mumbai	X-ray shows homogeneous opacity in the right upper lobe with upward shift of transverse fissure and compensatory overinflation of lower lobes suggesting collapse of right upper lobe. Right upper lobe is the most common site of postextubation collapse as right main bronchus is in direct communication with trachea and right upper lobe has less collaterals.	Commonly seen in very low body weight (VLBW) infants who are directly extubated to oxyhood. Positioning and chest physiotherapy resolves the lesion in majority.

Tracheoesophageal Fistula

 **Figures 1.5.8A and B:** Tracheoesophageal fistula *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Radiograph depicts the coiling of the feeding tube in esophagus suggesting a blind pouch with presence of intestinal gas (Fig. 1.5.8A). In most cases, the upper esophagus ends and does not connect with the lower esophagus and stomach. The top end of the lower esophagus connects to the trachea. Common symptoms include drooling, coughing, gagging, choking or cyanosis with attempted feeding soon after birth. History of polyhydramnios in mother or absence of stomach gas on prenatal ultrasound strengthens the diagnosis.	• It is a life-threatening neonatal surgical emergency. A high index of suspicion is required for diagnosis. • The defect is confirmed by X-ray by inserting an 8F rigid red rubber catheter through nose or mouth till felt resistance to define the level of upper pouch (Fig. 1.5.8B). Absence of a gastric bubble indicates esophageal atresia without a tracheoesophageal fistula.

Picture	Note	Management

USG Skull-IVH

 **Figure 1.5.9:** USG Skull-IVH *Photo Courtesy*: Pradeep Suryawanshi, Pune	The US brain parasagittal view shows >50% of the ventricular area, distending the lateral ventricle suggestive of grade III IVH. Presentation occurs within first 5 postnatal days and may be clinically silent, salutatory or catastrophic. Risk factors in addition to prematurity include vaginal delivery, intrapartum asphyxia, respiratory distress syndrome, hypoxemia, acidosis, pneumothorax and seizures.	• Because one half of IVH are clinically silent, routine ultrasound screening should be performed on all infants less than 30 weeks gestation or with risk factors, at 7 to 14 days and 36 to 40 weeks post-menstrual age to detect IVH, periventricular leukomalacia (PVL) and ventriculomegaly. • A grading of severity is assigned based upon the location and extent of IVH.

1.6 NEWBORN SCREENING

Hearing Screening

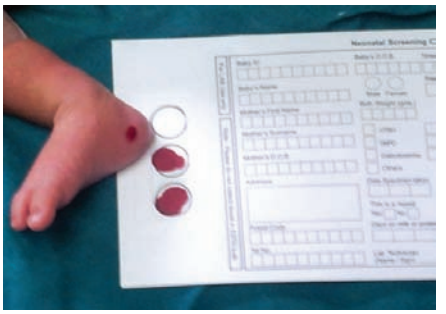
 **Figure 1.6.1:** Hearing screening *Photo Courtesy*: Ruchi Nanavati, Mumbai	The picture shows a newborn undergoing a hearing screen by otoacoustic emission method. This is done in a quiet room with sedation ensuring the ears are clean with one ear tested at a time. If the test result is abnormal, complete evaluation including diagnostic BERA, impedence audiometry and free-field audiometry is warranted. Behavioral audiometry is done only if screening facilities not available. JCIH recommends ABR technology as the only appropriate screening technology in NICU.	Early hearing detection and intervention (EHDI) is essential to maximize linguistic competence and literacy development in children with hearing impairment. • Screen all newborns by 1 month of age • Diagnose hearing loss by 3 month of age • Link the infant to intervention by 6 month of age Infants with any degree of bilateral or unilateral permanent hearing loss is considered eligible for early intervention (EI).

Hypoglycemia Screening

 **Figure 1.6.2:** Hypoglycemia screening *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	The screening is done for "at risk" newborn viz-IUGR, infant of diabetic mother, outborns, sepsis, postexchange transfusion, etc. A heel prick capillary sample with value < 40 mg% suggests hypoglycemia and warrants treatment pending venous sample testing by glucose oxidase method in lab which is confirmatory.	• Hypoglycemia is a common metabolic disorder. A hypoglycemic infant requires meticulous management and search for underlying cause. • These infants are at risk for occipital infarcts, seizures and neurodevelopmental sequelae.

Picture	Note	Management

Metabolic Screening

 **Figure 1.6.3** Metabolic screening *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	Newborn screening for several metabolic disorders is done by heel prick with sample taken on filter paper. The commonly screened metabolic disorders include congenital hypothyroidism, galactosemia, cystic fibrosis, congential adrenal hyperplasia and G6PD deficiency.	Metabolic screening is just not testing but incorporates confirmation, counseling, follow-up and long-term management.

Retinopathy of Prematurity (ROP) Screening

 **Figure 1.6.4:** ROP screening *Photo Courtesy*: Pradnya Deshmukh, Aurangabad	Screening for ROP is done bedside using an indirect ophthalmoscope by a specialist ophthalmologist (using topical drops for pupillary dilatation and local anesthesia). Screening should be performed in all preterm neonates (< 34 weeks) and/or < 1750 gm birth weight at four weeks postnatal age.	• Retinopathy of prematurity (ROP) is a developmental vascular proliferative disorder that occurs in retina of preterm infants with incomplete retinal vascularization • The incidence and severity of ROP increase with decreasing gestational age and birth weight. • Treatment is indicated for high-risk prethreshold and threshold disease to prevent blindness.

1.7 HUMANE NEONATAL CARE

Developmentally Supportive Care

 **Figure 1.7.1:** Developmentally supportive care *Photo Courtesy*: Rhishikesh Thakre, Aurangabad	The picture shows a preterm baby being nested—provided boundaries for comfort and containment—while receiving ongoing care in NICU. This is one of the intervention practiced while rendering DSC to neonates. Other measures include Kangaroo care, clustering of activities, calming measures following procedures, reducing noise and light exposure along with family centered care. It encompasses integrated developmental care interventions individualized for each baby and environmental changes to make NICU "baby friendly". The purpose is to lessen the negative effects of hospital care and minimize the stress newborns experience.	Research indicates that babies who are cared for using the individualized developmental care approach have fewer medical complications, shorter stays in the hospital, better weight gain and better developmental outcomes.

Picture	Note	Management

Kangaroo Care

 **Figure 1.7.2:** Kangaroo care *Photo Courtesy*: Ruchi Nanavati, Mumbai	The picture shows a preterm baby in NICU being placed in vertical position with direct skin-to-skin at mothers chest between her breasts. The head is covered and baby is nursed in Kangaroo bag supported by mother. Kangaroo Care (KC) is a low cost, comprehensive method of care for stable low birth weight (LBW) infants. In KC, the baby is breastfed exclusively. KC fosters the baby's health and wellbeing by promoting effective thermal control, breastfeeding, infection prevention and bonding.	• KC should be started as soon as the baby is stable. Mother acts as a source of warmth, nutrition and multimodal stimulation. Skin-to-skin contact promotes lactation and facilitates the feeding interaction. • KC should be continued till baby reaches 40 weeks post conceptional age or attains weight of 2500 gm. • KC should be practiced at all levels of neonatal care. It is important to realize that KC is not a poor man's choice but ideal way of humanizing sophisticated care imparted at tertiary level units.